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Within each well-defined field of science, where cooperative projects of the kind I have indicated are in operation, there should be and naturally would be provided a general coordinating board of strong, aggressive but tactful leaders, small in numbers, but alert and far seeing, who would guide, not direct, the effective organization and development of the cooperative idea.

Such a board must be constituted through the free and well considered choice of a democratic electorate. I believe that the plan which will insure most satisfactory and effective results is the selection of a leader by vote of all the cooperating workers in the field. The leader to select, subject to their approval the remaining members of the board. The size of the board, tenure of office and other details of a like nature are of relatively little importance so long as they remain subject to the control of a live democracy.

To hold that such a program as I have here outlined can be carried through easily and without difficulties would be to acknowledge ignorance of human nature. The selfishness of individuals has always been the chief obstacle to cooperative undertakings and selfish ambition is not uncommon among scientific men. Yet the measure of the success of true democracy will always be the extent to which this human weakness is suppressed and eliminated. Cooperation among scientists for the solution of problems must come. In no other way shall we be able to rise to the demands and the opportunities of the age. The pioneer days of science are largely over and progress is to be made only by organized and united effort. Why shall not the botanists of America lead? Already one group among us has indicated the possibilities in this direction. Botany in its broadest sense must justify itself in an economic world even as chemistry is doing and there is no want for opportunities. Colleagues shall we organize, shall we cooperate, shall we coordinate, and shall we show the way?

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### ON DUTY-FREE IMPORTATION

BEFORE the great war, the practise of importing duty free many things required by educational institutions had become so thoroughly established as to be regarded as part of the normal course of events. What had first been regarded as a special privilege came to be looked upon as a special right; and institutions, justly or unjustly, considered themselves entitled to purchase anything required for their maintenance in the lowest world market and to do this quite regardless of any conditions of high tariff or low tariff. Prohibitive tariff; protective tariff; tariff for revenue only had little or no interest for them. "Made in Germany," "Made in Japan," "Made in England," were more familiar inscriptions on laboratory apparatus than "Made in America."

In August, 1914, duty-free importation was stopped and now for the first time it is possible to resume it again. The question of whether or not it is desirable to do so is to the mind of the writer a pertinent one.

That it was the part of wisdom and good policy in the early days of our country when "higher education" was represented by a few denominational institutions, mainly supported by private contributions to grant them the privilege of importing without duty the instruments necessary for their research, is beyond question.

Science was practically unknown in this country; in fact, science as we know it to-day was almost unknown in the world. The amount of apparatus required by all the world was but a small fraction of that now utilized by America alone. An astronomical telescope, a compound microscope, a spectroscope was a rare instrument for which the world must be sought over, and having located an instrument of scientific interest, what more natural than that the pioneers of science in this country should be allowed to import it duty free? They were furthering the development of science and education and helping to create the demand that now exists for enormous quantities of such instruments, many of which have developed entirely out of the class of scientific

curiosities and experimental instruments and become everyday tools of trades and professions.

That it was the intention of the legislators to accomplish this very end is evident from the wording of the act granting the privilege. In enumerating the list of free goods it includes: (A) "Books, maps, music, engravings . . . publications (not including advertisements) for gratuitous circulation." (B) "Publications, *not more than two in any one invoice* in good faith for the use of any society or institution, incorporated solely for religious, philosophical, educational, scientific or literary purposes." (C) "Philosophical and scientific apparatus, utensils, instruments and preparations including boxes and bottles containing the same in good faith for the use and by the order of any society or institution" as above described "and not for sale."

These three provisions are incorporated in the same act and referred to in the same paragraph in 1918 annotated edition of Federal Laws. Does it not appear reasonable that if the original framers of these laws could have looked far enough into the future to see the enormous number of identical instruments now imported by single institutions for use in student laboratories, and thus virtually sold to the students in their payment of tuition and rents, even though the institution may retain its title to them till they are worn out, that they might have added the same provision in regard to instruments that was set down concerning books of learning, viz: "not more than two in any one invoice"?

It is of interest too to note the trend of opinion as to what was intended to be granted by this provision and what constitutes "philosophical instruments" by noting the interpretations that have been put on the question by the courts.

In 1890, one Oelschlaeger imported a consignment of mixed goods, all of which he claimed were to be classified as "philosophical instruments" and entitled to the special provisions and exemption due to goods so classified. Robertson, an official whose duty involved the appraising of goods and classifying them for rates of duty, declined to accept this

classification and demanded the duty on them when classified as "mechanical instruments." Oelschlaeger brought suit for the recovery of duty so paid. The court found for the defendant in a portion of the goods and for the plaintiff in another portion. In handing down the decision, the following language was used:

The most that can be done, therefore, is to distinguish between those implements that are used more especially in making observations, experiments and discoveries and those which are more especially used in the arts and professions. For example; an Astronomical Telescope, a Compound Microscope, a Ruhmkorf coil, would be readily classified as philosophical instruments or apparatus. While the instruments commonly used by surgeons, physicians and navigators for the purpose of carrying on their several professions and calling would be classified amongst mechanical implements, or instruments for practical use in the arts and professions. . . .

Continuing the quotation:

It is somewhat difficult [said the Court] in practice to draw a line of distinction between the two classes in as much as many instruments originally used for the purpose of observation and experiment have since come to be used partially or wholly as implements in the arts.

Among the goods included in this particular consignment were a high-grade compound microscope, a small and simpler microscope for the examination of textiles and an ophthalmoscope. The former of these three instruments were held to be philosophical instruments, while the two latter were not deemed entitled to this classification.

In a similar case in 1885 in *Manassee vs. Spalding*, it was held that anemometers, hygrometers, Ruhmkorf coils, galvanometers, Geissler tubes, Granet batteries and radiometers were "philosophical apparatus," but that surveyors' compasses could not be so classified.

We fail to find any recent court decision in regard to the separation of instruments into philosophical apparatus and the implements required for pursuing a given trade or profession, but viewed in the light of the case just cited it seems to us not improbable that if the court were called on now to render a

decision distinguishing philosophical instruments from working tools, that many instruments now classed as "philosophical" would be found to have progressed into the class of instruments for practical use.

It is reasonable to consider not only the intention of the law originally passed and its subsequent interpretation by the courts, but to ask ourselves the question, what policy at the present time is just and what would most tend to the development of scientific research? Let us grant, if you wish, that educational institutions whether private, semi-private, as those partially supported by private contributions, and partially by taxation, or entirely public as our great state universities, are entitled to subsidy from the federal government. Is such subsidy best granted by exempting them from paying duty on certain classes of goods and not on others?

Let us consider for example a great university in process of building. For its halls it will require a large amount of window glass; for its chemical laboratories it will require glass beakers, flasks, etc. Both are essential, both are made in America and both are protected by duty, but the university enjoys especial exemption from paying duty on one and not the other.

We deem it not just to thus discriminate against the manufacture of the glass that happens to be used for scientific purposes.

Not justice alone, but also expediency must be considered in determining a national policy, for manifestly the apparent rights of one individual or firm should not be allowed to prevail in opposition to the general good. We, therefore, consider lastly the question, Is it expedient in case of tariff resumption to exempt schools and colleges?

Education in this country is no longer an "infant industry." There were listed in Patterson's Educational Directory for 1916 approximately 700 colleges and universities, embracing 144 technical schools, 31 schools of mines, 137 schools of agriculture, 20 schools of forestry, 128 schools of medicine, 60 schools of dentistry, 31 schools of metallurgy, 91 schools of pharmacy and 27 schools of veterinary medicine. These do not include normal

schools and "teachers' colleges" of which there are about 450, to say nothing of the enormous number of public and private secondary schools, schools of domestic science and others requiring varying amounts of "scientific and philosophical" apparatus. Who can estimate the extent of the requirements of these institutions for apparatus and materials more or less properly classified as "scientific"? They are certainly of sufficient magnitude to be worthy of the best brains and best energy America can produce. By the policy of duty-free importation such brains and such energy will be diverted to channels yielding greater immediate financial returns.

Furthermore, research and investigation, while interesting, to be of benefit to humanity must be developed to practical ends. The application of scientific research to all the arts and industries was never so prevalent or necessary as at the present time. Scientific apparatus is now as necessary to the development of many of our important industries as to the training of men to do the work. These industries constitute a further demand for scientific and technical instruments that is sufficient to aid greatly in supporting American manufacturers of such goods, and we believe that in the long run the cause of education can best be served by permitting educational institutions to aid in the developing of these industries under a policy of protection commensurate with that accorded the production of other necessities for the comfort, prosperity and progress of the great mass of American people.

It is true that at the present time certain instruments, notable among which are spectrometers, polarimeters, refractometers, etc., necessary or desirable for the advancement of science, are not manufactured in this country, and it is also true that under present industrial conditions their manufacture can not be begun in competition with European instruments imported duty free; but we believe, furthermore, that it is true that their manufacture once begun American competition would develop American efficiency, and that in a short time our institutions would be better served by Americans than they have been in the past by Europeans.

It appears to us that the duty-free privilege has, in a measure at least, defeated its own end in depriving the American manufacturer of means necessary to put the time, thought and experiment into high-grade scientific instruments which is requisite for real progress, leaving us dependent on foreigners for such investigations and the advancement incident thereto. If a few have apparently been able to make a notable exception of their products, this has been accomplished only by placing on a purely commercial basis an industry which ought to be, in fact, must be, for long-continued success based on the firm foundation of scientific research. The impossibility of properly conducting such research has often reduced us to the status of imitators dependent for our own progress upon investigations conducted on the other side of the ocean.

If it has been impossible, under existing conditions, to manufacture or properly develop instruments already known, what can be expected in the way of new instruments to accomplish new purposes. Increasing and expanding research calls for new and modified instruments and, *vice versa*, new instruments uncover new lines of research. In other words, the two go hand in hand. The retarding of one retards the other, and the stimulation of one stimulates and helps the other.

What is true in regard to science in the abstract is equally true in regard to men doing scientific work. The development of the manufacture of scientific instruments under a protective policy will thus react favorably on the educational institutions themselves by building up a demand for their graduates.

It is manifestly absurd to endeavor to discriminate between a policy beneficial to educational institutions and one desirable for the people as a whole. Our educational system from the kindergarten to the university is our very life blood; we can not promote the institution to the detriment of the people, nor can we favor other interests at the expense of the institution.

The great bulk of education in our country is supported, as it should be, by taxation. Is it best to contribute to their support by the kind of subsidy that grants them special privileges

in regard to certain classes of goods, at the same time making them dependent on foreign manufacturers; or by the very slightly increased taxation necessary to develop American independence in scientific instruments as in other lines of industry?

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### THE DIVISION OF ENGINEERING NATIONAL RESEARCH COUNCIL<sup>1</sup>

THE War Organization of the Engineering Division comprised four sections; a section on metallurgy, a section on mechanical engineering, a section on electrical engineering, and a section on prime movers. The work of each section was under a chairman, who was directly responsible to the chairman of the division.

The section on metallurgy had for its principal work the solving of metallurgical problems arising in connection with the conduct of the war, more particularly those brought to it by the military. This work was accomplished through the medium of committees, whose personnel included leading authorities upon metallurgy.

The section of mechanical engineering established a drafting room in charge of a chief draftsman at research council headquarters and through the generosity of the Carnegie Institute of Technology a machine shop at Pittsburgh under the direction of a foreman. These were used for the development of inventions referred to the section by the physics and engineering divisions.

The section on electrical engineering concentrated its efforts upon the problem of electric welding, more particularly electric welding as applied to ship building. This section worked in very close cooperation with the Emergency Fleet Corporation, who financed its investigative work.

The section on prime movers devoted its attention chiefly to the design and development of power plants for aircraft.

<sup>1</sup> Address given at joint session of the National Academy of Sciences with National Research Council, April 30, 1919, Smithsonian Institution, Washington, D. C.